NATO INTERNATIONAL STAFF - DEFENCE SUPPORT DIVISION

TRIAL SERIES 09

ERGONOMICS

AVTP	TEST TITLE
09 – 10	Workspace Measurement
09 – 20	External Vision of Crewmembers
09 – 30	Noise
09 – 40	Shock and Vibration and Ride Qualities
09 – 50	Toxic Risks
09 – 60	Air Conditioning
09 – 70	Workspace Illumination
09 – 80	Task Analysis
09 – 90	Speech Intelligibility
09 – 100	Psychophysical Stress

ALLIED
VEHICLE TESTING
PUBLICATION

AVTP : 09-10
EDITION NO.: FINAL
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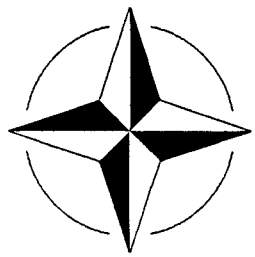

NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : WORKSPACE MEASUREMENT

REFERENCE : STANAG 4357
STANAG 4358

EQUIVALENT : WEU 4FT6 NO.: TM 09-10

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting workspace measurement tests under static and dynamic conditions taking user population into account.

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NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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RECORD OF CHANGES, AMENDMENTS AND RESERVATIONS *)

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*) See Reservations Overleaf

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Trial Series: ERGONOMICS

Test Title : WORKSPACE MEASUREMENT

Paragraph

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DATE : SEP. 1991

1. SCOPE

This document describes the procedures for conducting workspace measurement tests of vehicles. A serviceable workspace is a necessary condition for the satisfactory performance of a man-machine system.

In addition, the workspace layout should accommodate the specified range of the user population. The following procedures are directed towards the evaluation of the workspace layout of the crew under static and dynamic conditions on the basis of measurement and observational evidence.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

a. Paved road course, with hills if possible
b. Cross-country course, with hills if possible

2.2. Instrumentation

DEVICES FOR MEASUREMENT OF:	PERMISSIBLE ERROR OF MEASUREMENT*
a. Distance	2 %
b. Angles	10 mrad
c. Operating forces	2 %
also: Film and/or video equipment and appropriate questionnaires	-

* The permissible error of measurement for instrumentation is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

AVTP : 09-10
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3. REQUIRED TEST CONDITIONS

3.1 Test Vehicle

a. The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan. The vehicle must be fully stowed with personal weapons and equipment. Vehicle tools and equipment should be properly stowed in the vehicle.

b. All operating controls and indicators are to be inspected and adjusted to standard technical and operational specifications.

3.2 Test Participants

a. Choose test personnel according to the user population or the Military Occupation Speciality requirements.

b. Anthropometric measurements should be related to the required range of the user population.

c. The functionally correct operating positions are to be used at all measurement locations, including the standing operator. Dimensions are to be taken from the Seat Reference point except for the standing operator.

d. The prescribed representative summer, winter and special clothing is to be used.

4. TEST PROCEDURE

The data acquisition must concentrate on the following areas:

4.1 Stationary Tests

a. Entry to and exit from the workstation, including step security.

b. Emergency escape and rescue.

c. Space relationships for operationally relevant freedom of movement for the whole body and for parts of the body, while functioning in the workspace, and wearing clothing appropriate to the prevailing worst case conditions. Far reach at a maximum for the small crewman near reach at a minimum for the large crewman.

d. Clearance distances from fixed surfaces and components, including moving parts, when they are subjectively assessed as potentially degrading operator performance.

e. Functional use of the workstation for continuous operations, so that the operation is simple logical and does not cause confusions to the operator, especially during stressful situations (see AVTP 09-100).

f. Ergonomic presentation and location of controls and display.

g. Operating forces required to overcome the resistances of important controls as well as the opening and clothing of hatches and doors, under control, on all slopes on which the vehicle is required to operate.

h. Access to and storage of personal equipment.

i. Ease of crew/operator maintenance.

j. Risk of injury from projections and adequacy of guards to prevent inadvertent operation of controls.

k. Seating assessment and safety harnesses to provide correct postural support for efficient operation of the workstation.

4.2 Mobile Tests

a. Safe operation of all controls including the provision of non-slip surfaces.

b. Clear, easily understood displays.

c. Controlling the vehicle, over rugged terrain, including the wearing of restraining harnesses to reduce the risk of injury from secondary impacts inside the vehicle.

d. Steering forces required for turning.

4.3 Subjective Assessment

a. The assessment should concentrate on the qualitative examination of the conduct of work including critical operational sequences and combined mental and physical tasks.

b. The levels of judgment should, if possible, distinguish 6 or more scale values.

c. The confidence level should be 95% and as further detailed in the parameters for any specific test.

d. Comments from other testing such as Endurance Tests should be acquired if possible.

5. DATA REQUIRED

a. Description of critical components to include photographs and videotapes of problem areas and tasks.

b. Distance measurements.

c. Angular relationships.

d. Activation forces.

e. Comments on the ergonomic compatibility of the workstation with the operator.

f. Comments on safety aspects.

g. Comments about effectiveness of training.

h. Comments on any restriction to test participants.

i. Results of the subjective rating.

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6. PRESENTATION OF DATA

Present the required data in narrative, tabular, graphical, pictorial or other format as appropriate.

Include:

a. Critical areas according to degree of degradation by measurement and observation.

b. Recommended improvements.

c. Results of subjective ratings.

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VEHICLE TESTING
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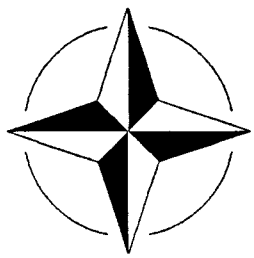

NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : EXTERNAL VISION OF CREWMEMBERS

REFERENCE : STANAG 4357
STANAG 4358

EQUIVALENT : WEU 4FT6 NO.: TM 09-20

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting external vision tests. Sufficient vision is necessary to avoid accidents and for performance during battle.

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NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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FOR THE MILITARY AGENCY OF STANDARDIZATION

(Signature)

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*) See Reservations Overleaf

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Trial Series: ERGONOMICS

Test Title : EXTERNAL VISION OF CREWMEMBERS

Paragraph

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DATE : SEP. 1991

1. SCOPE

Maximum practicable external vision appropriate to the vehicle and crew roles both for by day and night and in all prevailing weather conditions is a necessary precondition for the reliability and performance capability of a man-machine system. Viewing through sighting devices both optical and optronic may limit the perception of the external scene due to weather (rain, mud, ice and snow etc.) on the external surfaces of the optics. This is likely to degrade the performance of the operator by increasing the risk of accidents, causing protracted increases in effort to complete the specialist tasks and maintain attention and concentration. The evaluation of vision capability provided for crewmembers is dependant on the crew role i.e. Command/Control, Surveillance and Target acquisition, Gunnery and Driving.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

a. Level, flat Test area

b. Level, flat road course

c. Cross-country course, with hills if possible

d. Climatic chamber and, if required, a device for producing ice and mist on vision and sighting devices.

2.2 Instrumentation

DEVICES FOR MEASUREMENT OF:	PERMISSIBLE ERROR OF MEASUREMENT*
a. Distance	2 %
b. Angle	10 mrad
c. Level of illumination	5 %
d. Time	5 %
e. Speed	5 %
f. Atmospheric conditions	
Pressure	1 %
Humidity	3 %
Temperature	1 °C
also: Questionnaires and photographic equipment as necessary	-

* The permissible error of measurement for instrumentation is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

3. REQUIRED TEST CONDITIONS

3.1 Test Vehicle

a. The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan.

b. All viewing devices and light sources must be mounted and adjusted according to technical specifications and should be compatible with the wearing of full individual protective equipment.

3.2 Test Courses and Atmospheric conditions

The test area and the road course conditions should preferably be dry. Visibility range must be at least to the far range target locations, if applicable.

3.3 Test Participants

a. Choose test personnel corresponding to the user population or the Military Occupation Specialty requirements.

b. The special eyesight standard for armoured vehicle crewmen should be met if applicable.

c. All crew positions are to be occupied respectively by crewmen measuring within the required percentile range of the user population in sitting eye height.

d. The functionally correct sitting position is to be adopted at all measurement locations to allow a common eye reference level to the viewing device, if possible.

e. The prescribed representative summer, winter and special clothing is to be used.

4. TEST PROCEDURE

4.1 Stationary Tests

Driver

a. All external vision devices should be tested under daylight conditions for the following characteristics:

1) Vision of the ground over 360 degree at intervals of 10 degree.

2) Peripheral vision at eye height.

3) Vertical sight angle in the principal axis of sight. The zone swept by the external cleaning system should be taken into account.

b. Under night conditions the illumination of the course should be measured in the direction of travel under high- and low beam, blackout, if possible, and other illumination conditions. The measurements should be made at intervals of 3.5, 10, 25, 50, and 100 m from the source of illumination, and at angles of 10 degrees to both sides of the principal axis of illumination until background illumination levels are reached.

4.2 Mobile Tests

a. Under daylight conditions a cross-country course (desirably of at least 10 km), unknown to the driver, is to be driven at the highest safe speed in both the opened up and closed down hatch conditions if applicable. Resulting reductions in the cleanliness of optics are to be documented.

b. A similar, unknown cross-country course should be run at night under blackout (as far as possible) and other illumination conditions. Restrictions resulting from variations in sitting position are to be documented.

c. Drive the vehicle in reverse to evaluate visibility to the rear.

4.3 Replication

a. Stationary measurements under daylight conditions are to be repeated with tests subjects representing the 5th, 50th, and 95th percentile eye height size (see 3.3 a).

b. The night illumination measurements do not need to be repeated if the background conditions have remained constant.

c. Mobile tests should be repeated until a statistical confidence of 95 % can be achieved, and as further detailed in the parameters for any specific test.

4.4 Subjective Assessment

a. The assessment should be given in the form of a self administered but properly supervised questionnaire and concentrate on the qualitative assessment of external visual conditions that cannot be addressed by direct measurement.

b. The levels of judgement should distinguish among six or more scale values.

c. The level of confidence should be 95 %.

d. Comments from other testing such as Endurance Tests should be acquired if possible.

5. DATA REQUIRED

a. Peripheral vision at eye height.

b. Visual angle in the vertical plane along the principal visual axis.

c. Illumination level in lux at the points of measurement described above.

d. Minimum distance for visibility of the ground from the vehicle.

e. Horizontal visual angle.

f. Swept area covered by cleaning devices.

g. Cleared area covered by de-icing equipment.

h. Light intensity of illumination on the driving course and the surroundings.

i. Time required to clean devices.

j. Time required to de-ice devices.

k. Time to complete runs.

l. Average speed.

m. Results of the subjective evaluation.

6. PRESENTATION OF DATA

Present the required data in narrative, tabular, graphical, pictorial or other format as appropriate.

Include:

a. Visibility of the ground around the vehicle in the form of a polar diagram, and picture. Any blind/blanking areas where external vision is disrupted should be recorded.

b. Definition of the visual reference point (from seat reference point).

c. Description of the icing or misting procedure.

d. Time required to clear viewing devices.

e. Illumination level in lux at the points of measurement described above.

f. Time to complete the mobile tests together with average speed in km/h.

g. Results of the subjective interviews.

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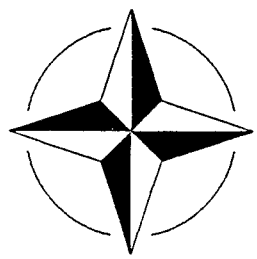

NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : NOISE

REFERENCE : STANAG 4357
STANAG 4358

EQUIVALENT : WEU 4FT6 NO.: TM 09-30

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting noise tests. Noise may limit communication or cause physical damage.

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NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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FOR THE MILITARY AGENCY OF STANDARDIZATION

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*) See Reservations Overleaf

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Trial Series: ERGONOMICS

Test Title : NOISE

Paragraph

AVTP : 09-30
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1. SCOPE

The effects of noise level and duration may reduce the performance of vehicle operators. In addition, irreversible physical damage may be caused, over time, by very high levels.
This test procedure is directed towards the acquisition of data to assess the ambient noise levels of wheeled and tracked vehicles.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

a. Straight, level paved road
b. Cross-country course with hills if possible
c. Winding paved road circuit with hills if possible

2.2 Instrumentation

DEVICES FOR MEASUREMENT OF:	PERMISSIBLE ERROR OF MEASUREMENT*
a. Sound level (sound pressure level)	1.5 dB
b. Speed	5 %

also:
Questionnaires

* The permissible error of measurement for instrumentation is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

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DATE : SEP. 1991

3. REQUIRED TEST CONDITIONS

3.1 Test Vehicle

The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan.

3.2 Test Participants

a. Choose test participants corresponding to the user population or the Military Occupation Specialty requirements.

b. Test participants should have normal hearing acuity confirmed by audiometric tests.

c. The correct sitting or standing position should be adopted at all crew stations.

d. The prescribed representative summer, winter and special clothing is to be used.

4. TEST PROCEDURE

In all cases, the pressure sensor must be located near the ear location of the crewmember position of interest. As a minimum, sound level measurements should be taken with open and closed hatches and/or windows, and with ventilators running, under the following conditions:

4.1 Stationary Tests

a. Main engine off, ancillary equipment on, where possible.

b. Main engine idling, ancillary equipment off.

c. Main engine at speed, required for operation of ancillary equipment, ancillary equipment on and off.

d. Any other conditions as appropriate for the test vehicle configuration.

4.2 Mobile Tests

a. Tests will be carried out on the straight and winding paved road course at constant, stabilized speeds of 10, 30, 50 km/h, maximum speed, and any other speed likely to generate maximum sound levels.

b. Drive the vehicle on the cross country course, at the maximum speed at which the vehicle can be safely driven.

4.3 Replication

The measurements relating to straight paved road and winding paved road need only be taken once, whereas those relating to the cross country course must be repeated at least twice.

4.4 Subjective Assessment

a. The questions should concentrate on the annoyance caused by the noise.

b. The assessment ranking should cover a scale comprising at least six levels.

c. The confidence level should be 95 % and as further detailed in the parameters for any specific test.

d. Comments from other testing such as Endurance Tests should be acquired if possible.

5. DATA REQUIRED

a. Overall noise level in dB(lin) and dB(A).

b. Level per octave or 1/3 of an octave in dB(lin).

c. Driving speed in km/h, gear engaged and engine speed.

d. Results of the subjective assessment.

6. PRESENTATION OF DATA

Present the required data in narrative, tabular, graphical, pictorial or other format as appropriate.

Include:

Noise spectra and overall levels for each location and condition tested.

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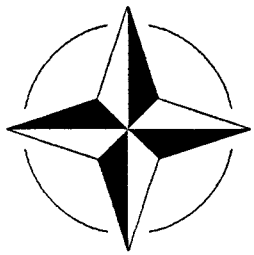

NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : SHOCK AND VIBRATION AND RIDE QUALITIES

REFERENCE : STANAG 4357
STANAG 4358
ISO 2631
ISO 5349

EQUIVALENT : WEU 4FT6 NO.: TM 09-40

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting shock and vibration tests. The effects on humans can be performance-limiting or cause physical reactions.

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NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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FOR THE MILITARY AGENCY OF STANDARDIZATION

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Trial Series: ERGONOMICS

Test Title : SHOCK AND VIBRATION AND RIDE QUALITIES

Paragraph

AVTP : 09-40
EDITION NO.: FINAL
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1. SCOPE

The effects of mechanical vibration on humans become performance-limiting under conditions of high vibration loading. Moreover, severe vibration loads can result in physical reactions of the skeleto-muscular system, blood circulation, and the internal organs. The present test procedures are directed toward the evaluation of the stress of translational vibration under field conditions as determined on the basis of measurements and observations. Investigations of stress arising from rotary vibration are not part of this procedure.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

a. Straight, level road courses, paved and gravel

b. Belgian Block course

c. Special tracks and obstacles, as required.

d. Hilly cross-country course as required.

2.2 Instrumentation

DEVICES FOR MEASUREMENT OF:	PERMISSIBLE ERROR OF MEASUREMENT*
a. Acceleration	2 %
b. Speed	1%

also:
Questionnaires

* The permissible error of measurement for instrumentation is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

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3. REQUIRED TEST CONDITION

3.1 Test Vehicle

a. The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan.

b. Crew and/or passenger weight at workstations not being measured can be simulated by weights.

3.2 Test Courses

The courses should be free of snow and ice.

3.3 Test Participants

Choose test personnel according to the user population or the Military Occupation Specialty requirements.

4. TEST PROCEDURE

4.1 Mobile Test

a. All crew positions are to be occupied by subjects or simulated crew measuring approximately 50th percentile in weight, in addition 5th and 95th percentile if desired.

b. The functionally correct operating positions are to be used at each crew station. The driver should be in contact with the seat during the test.

c. The paved, gravel and belgian block courses are to be driven at constant speed, starting with 10 km/h, and increasing in increments of 10 km/h, up to the maximum safe speed. Tests will be carried out at any other speed likely to generate maximum vibration levels.

d. The speed towards each obstacle if required, should begin with 5 km/h and be increased in increments of 5 km/h up to maximum safe speed.

e. The cross-country course is to be driven for at least 15 min. at the highest possible safe speed, in accordance with test course regulations.

f. Harnesses must be worn if fitted to the vehicle under test.

4.2 Replication

Measurements on the paved course need be done only once, but those on the other courses should be repeated with three different drivers.

4.3 Subjective Assessment

a. The assessment should concentrate on perceptible vibration and the probability of stressfulness.

b. The levels of judgement should distinguish among six or more scale values.

c. The level of confidence should be 95 %, and as further detailed in the parameters for any specific test.

d. Comments from other testing such as Endurance Tests should be acquired if possible.

5. DATA REQUIRED

a. Description of the seating system.

b. Acceleration, in three axes, of the seat in relation to the center of effective energy transfer.

c. Acceleration in three perpendicular axes, of the seat anchor point.

d. Acceleration on the steering wheel, pedals, or other critical body contact point in the principal axis of effect.

e. Other ergonomically relevant points of acceleration.

f. Duration of test conditions.

g. Driving speed.

h. Description of each obstacle used for test.

i. Results of the subjective evaluation.

j. Effects on vision performance of vehicle occupants, relative to the role of the vehicle.

6. PRESENTATION OF DATA

Present the required data in narrative, tabular, graphical, pictorial or other format as appropriate.

Include:

a. Unevaluated effective readings of the acceleration in m/s^2 for all test conditions.

b. Effective readings for all test conditions evaluated according to ISO 2631/1 (Evaluation of human exposure to whole body vibration - Part 1: General requirements) and ISO 5349 (Mechanical vibration - Guidelines for the measurement and assessment of human exposure to hand-transmitted vibration).

c. Acceleration as a function of frequency for especially critical test conditions.

d. Frequency response function (seat damping effect) between measured values for seat and vehicle floor.

e. Results of the subjective ratings.

f. Description of the test courses.

g. Specification of data format (the raw, weighted and unweighted)

ALLIED
VEHICLE TESTING
PUBLICATION

AVTP : 09-50
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NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : TOXIC RISKS

REFERENCE : STANAG 4357
STANAG 4358

EQUIVALENT : WEU 4FT6 NO.: TM 09-50

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting tests for identifying and measuring toxic gases from burning fuels in engines and heaters. Hazards from weapons gases are not included.

28.07.91

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NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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FOR THE MILITARY AGENCY OF STANDARDIZATION

(Signature)

AVTP : 09-50
EDITION NO.: FINAL
DATE : SEP. 1991

RECORD OF CHANGES, AMENDMENTS AND RESERVATIONS *)

Identification of Change or Amendment and Reg.No.(if any) and date	Date Entered	NATO Effective Date	By whom entered Signature, Rank, Grade or Rate, Name of Command

*) See Reservations Overleaf

AVTP : 09-50
EDITION NO.: FINAL
DATE : SEP. 1991

OVERLEAF TO PAGE 3

RESERVATION

United States: Tests requiring human subjects, as part of the materiel acquisition process in the United States military, are not typically performed on a regular basis or reported as technical tests for specific materiel systems. Human experimentation to develop performance and health hazard data is usually performed as a special study under medical auspices.

AVTP : 09-50
EDITION NO.: FINAL
DATE : SEP. 1991

Trial Series: ERGONOMICS

Test Title : TOXIC RISKS

Paragraph

AVTP : 09-50
EDITION NO.: FINAL
DATE : SEP. 1991

1. SCOPE

The burning of fuels liberates toxic gases which, at various concentrations, influence psychophysical performance capability and ultimately, at higher concentrations, can result in loss of consciousness or even death. This test procedure is directed toward the observation and measurement of toxic hazards to the vehicle crew from engine and heater exhaust gases. Testing must include all crew stations and all possible hazardous configurations. The analysis of hazards from weapon gases is not part of this test procedure.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

a. Straight, level paved road course.

b. Cross country course, with hills if possible.

c. Swimming and fording basin (as required).

2.2 Instrumentation

DEVICES FOR MEASUREMENT OF:	PERMISSIBLE ERROR OF MEASUREMENT*
a. Carbon monoxide (CO)	5 %
b. Carboxyhaemoglobin (CO-Nb)	10 %
c. Carbon dioxide (CO_2)	5 %
d. Sulphur dioxide (SO_2)	5 %
e. Oxides of nitrogen (NO_x)	5 %
f. Hydrocarbons (HC)	5 %
g. Wind speed	5 %
h. Driving speed	5 %

i. Temperature	1 °C
j. Barometric pressure	1 %
k. Relative humidity	3 %

also:
Questionnaires

* The permissible error of measurement for instrumentation is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

3. REQUIRED TEST CONDITIONS

3.1 Test Vehicle

a. The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan.

b. Engine, auxiliary engine and heaters must be correctly adjusted according to technical specifications.

c. Testing should be conducted to include auxiliary devices that affect distribution of engine or heater exhaust, such as applique armour, fording and swim kits, etc.

d. Either an alarm or a respirator (or both) is required for the test personnel in case maximum allowable workplace concentrations of toxic gases are exceeded.

3.2 Test Courses

The paved course should be dry.

3.3 Test Participants

a. Choose test participants according to the user population or the Military Occupation Specialty requirements.

b. If human subjects are used to acquire data, the crew positions are to be occupied by subjects measuring approximately 50th percentile at there operating positions.

c. Occupancy of the crew positions, other than the driver, is necessary only in conjunction with carboxyhaemoglobin or subjective measurements.

d. If human subjects are used to acquire data, the functionally correct sitting or standing position is to be adopted at all crew stations.

e. If human subjects are used to acquire data, investigations with test personnel are to be discontinued whenever the maximal workplace concentration is exceeded or when carboxyhaemoglobin is greater than 10 %.

f. The prescribed representative summer, winter and special clothing is to be used.

4. TEST PROCEDURE

Toxic gas measurements will be taken at the breathing zones of the crewmember positions of interest using the following procedure as a guide (modified for vehicle con figuration as required).

4.1 Stationary Tests

a. On level ground with opened and closed doors, windows and hatches, with all ventilator fans operating and off, with minimal (0.5 m/s) and, if possible strong (>6 m/s) wind conditions as follows:

1. Engine off, heater at half/low and full/high power, and auxiliary engine running if applicable.

2. Engine at idle, heater off.

3. Engine at idle, heater at half/low and full/high power.

b. During fording with engine idling.

4.2 Driving Tests

a. On land, with open and closed hatches and windows (as applicable), with the heater under half/low and full/high power as follows:

1. Paved road at constant speeds of 10, 30, and 50 km/h or any other speed considered to be applicable for at least 15 min or until levels of toxic substances stabilize.

2. Cross-country course at the maximum safe speed for at least 30 min or until levels of toxic substances stabilize.

b. Speeds for fording and swimming according to requirements.

4.3 Replications

Tests must be repeated whenever the values measured exceed the national or NATO Maximum-Allowable-Concentration. In such cases, stationary measurements are to be conducted without crewmembers. Driving tests are dependant upon breathing protection for the driver.

4.4 Subjective Evaluation

a. Questioning should concentrate on the specific smells and effects associated with harmful substances as well as on olfactory annoyance.

b. The level of confidence should be 95 %, and as further detailed in the parameters for any specific test.

5. DATA REQUIRED

a. Concentration (ppm) of harmful substances in test samples taken from the principal breathing zone of the crew.

b. Carboxyhaemoglobin levels as measured directly or indirectly.

c. Measurement time duration.

d. Wind speed.

e. Air temperature (interior).

f. Relative humidity (interior).

g. Vehicle speed.

h. Results of subjective evaluation.

6. PRESENTATION OF DATA

Present the required data in narrative, tabular, graphical, pictorial or other format as appropriate.

Include:

a. Concentration of CO, CO_2, SO_2, HC and NO_x in ppm over time.

b. Carboxyhaemoglobin content in percent for pre-post comparisons, if test subjects are used. When CO Hb is measured indirectly give mathematical equation used.

c. Results of subjective evaluation.

AVTP : 09-50
EDITION NO.: FINAL
DATE : SEP. 1991

ANNEX

GENERAL INFORMATION

CONTAMINANTS (TOXIC HAZARDS) SUMMARY. Toxic contaminants generated from various sources can have debilitating effects on the efficiency of occupants and operators of vehicles and ground equipment. The surreptitious nature of the build-up of some of these effects underscores the necessity for detecting, measuring, and eliminating these hazards to the fullest extent possible. The primary issue that must be addressed in this procedure is the potential overexposure of soldiers to carbon monoxide (CO), ammonia (NH_3), sulphur dioxide (SO_2), oxides of nitrogen (NO_x) and any other substance that has been identified as being hazardous to health/safety or contributing to degraded human performance.

Carbon Monoxide (CO). CO is an invisible, odourless and tasteless gas which gives no warning to exposed persons. This gaseous compound is one of the most dangerous and common industrial hazards. CO can have debilitating effects on both the health and efficiency of operators and occupants of both vehicles and other fossil-fuel-burning equipment.

The major effect of CO primarily results from impaired oxygen transport by the blood, thus resulting in hypoxia. Normally, oxygen from the lungs is carried through the body by the bloods haemoglobin (Hb). CO has a natural affinity for blood Hb and reduces the oxygen-carrying capacity of the blood thereby causing suffocation. The affinity of CO for Hb may be as much as 300 times greater than oxygen. The elimination of CO is solely through the lungs and is similar in many ways to absorption. The rate at which CO is eliminated from the blood is exponential, relatively slow, and is a function of many physiological variables. The half life of CO in the blood can be as high as 4 hours for healthy people at rest in an environment free of contaminants.

The prediction of carboxyhaemoglobin (COHb) blood levels may be made by using a mathematical equation such as the revised form of the Coburn-Forster-Kane (CFK) equation. This empirically derived equation predicts the percent of COHb blood levels in personnel exposed to CO through knowledge of the CO exposure level, duration of the exposure, and the work-stress level (ventilation rate) of the exposed individual. The equation is, therefore, a useful tool for evaluating the toxic hazard associated with exposure to CO.

Sulphur Dioxide (SO_2). SO_2 is a pungent, irritating gas produced in large quantity by the combustion of sulphur or compounds containing sulphur. Exposure to concentrations of 1 - 50 ppm for 5 - 15 minutes may cause irritation of the eyes, nose, and throat, nasal discharge, choking, coughing, and reflex constriction of the airways. Some 10 to 20 % of the healthy young adult population are estimated to be hypersusceptible to the effects of SO_2.

Other toxic gases associated with operation of military vehicles include ammonia (NH_3) and lead (Pb).

Oxides of Nitrogen (NO_x). Nitric oxide (NO) is readily formed during high temperature combustion. Its rapid reaction with oxygen in the air to form nitrogen dioxide (NO_2) means that it is never encountered without NO_2. NO_2 is considerably more toxic than NO, and is dissolved in water in the upper respiratory tract forming dilute nitric acid, which irritates the mucous membranes and lung tissue. Exposure to NO_2 concentrations of 5 to 50 ppm for 1 to 15 minutes may cause effects ranging from irritation to severe pain.

ALLIED
VEHICLE TESTING
PUBLICATION

AVTP : 09-60
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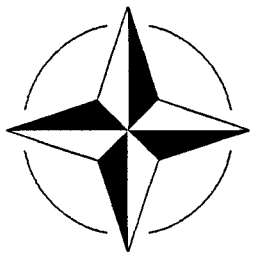
DATE : SEP. 1991



NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : AIR CONDITIONING

REFERENCE : STANAG 4357
STANAG 4358

EQUIVALENT : WEU 4FT6 NO.: TM 09-60

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting tests to measure the performance of the internal air conditioning (cooling and heating) at the crew workstation.

AVTP : 09-60
EDITION NO.: FINAL
DATE : SEP. 1991

NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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FOR THE MILITARY AGENCY OF STANDARDIZATION

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*) See Reservations Overleaf

AVTP : 09-60
EDITION NO.: FINAL
DATE : SEP. 1991

Trial Series: ERGONOMICS

Test Title : AIR CONDITIONING

Paragraph

AVTP : 09-60
EDITION NO.: FINAL
DATE : SEP. 1991

1. SCOPE

The psychophysical functioning of the human being is confined to a narrowly bounded range of internal temperatures. Severe climatic effects outside of these limits can stress the biological mechanisms of regulation and become performance limiting. The following test procedure is directed toward the evaluation of the internal air conditioning of the workplace as determined from measurements and observation. The measurement of biological parameters such as body temperature or sweating are not part of these procedures. Such physiological measurements can however be conducted simultaneously and be reported together. In order to fully understand the problems associated with air conditioning then it would be necessary for this additional measurement to be taken. Crew hot and cold habitability must be included.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

a. Straight, level paved road course.

b. Climatic chamber or location with hot or cold climate.

2.2 Instrumentation

DEVICES FOR MEASUREMENT OF:	PERMISSIBLE ERROR OF MEASUREMENT*
a. Air velocity	5 %
b. Air volume flow rate	10 %
c. Temperature	1 °C
d. Vehicle speed	5 %
e. Heat radiation	5 %

f. Relative humidity	3 %
g. Atmospheric pressure	1 %

also:
Questionnaires

* The permissible error of measurement for instrumentation is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

3. REQUIRED TEST CONDITIONS

3.1 Test Vehicle

a. The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan.

b. Air conditioning system must be correctly adjusted according to technical specifications.

3.2 Test Participants

a. Choose test participants according to the user population or the Military Occupation Specialty requirements.

b. The prescribed representative summer, winter and special clothing is to be used.

4. TEST PROCEDURE

Measurements should be taken with external ambient temperatures covering a range from +44°C to -20°C according to the diurnal cycle prevailing in high summer and winter.

4.1 Stationary Tests (Test chamber preferred)

a. Temperature measurements must be taken at the head and foot positions of the crew and with hatches closed (if applicable).

b. Take measurements with the vehicle engine off and at idle, and the air cooler or heater at half/low and full/high power.

c. Measurement should be continued for at least 30 minutes or until readings stabilise.

4.2 Mobile Test (only for natural environment)

a. Drive the paved road course at the maximum safe speed.

b. Temperature measurements must be taken at the head and foot positions of the crew and with hatches closed (if applicable).

d. Measurement should be continued for at least 30 minutes or until readings stabilise.

4.3 Subjective Assessment

a. Questioning should concentrate on the degree of impairment resulting from the climatic stress. For the subjective measurement the functionally correct sitting position will be used.

b. The evaluative rankings should span a scale of at least six levels.

c. The level of confidence should be 95 %, and as further detailed in the parameters for any specific test.

5. DATA REQUIRED

a. Air temperature at the head and foot height of the reference crew for the duration of each condition.

b. Average relative humidity at the centre of each crew station for each condition.

c. Average air speed at the head and foot position of the crew for each condition.

d. Heat radiation in the principal region of effect in relation to the human body with a 180 deg. aperture to the radiating surface for each applicable condition.

e. Air volume flow rate from the cooler or heater.

f. Climatic conditions.

g. Driving speed.

h. Results of the subjective assessment.

6. PRESENTATION OF DATA

Present the required data in narrative, tabular, graphical, pictorial or other format as appropriate.

ALLIED
VEHICLE TESTING
PUBLICATION

AVTP : 09-70
EDITION NO.: FINAL
DATE : SEP. 1991

NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : WORKSPACE ILLUMINATION

REFERENCE : STANAG 4357
STANAG 4358

EQUIVALENT : WEU 4FT6 NO.: TM 09-70

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting tests on illumination of workplaces.

AVTP : 09-70
EDITION NO.: FINAL
DATE : SEP. 1991

NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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FOR THE MILITARY AGENCY OF STANDARDIZATION

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DATE : SEP. 1991

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*) See Reservations Overleaf

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DATE : SEP. 1991

Trial Series: ERGONOMICS

Test Title : WORKSPACE ILLUMINATION

Paragraph

AVTP : 09-70
EDITION NO.: FINAL
DATE : SEP. 1991

1. SCOPE

With restricted daylight it is necessary to have sufficient glare-free illumination for visual information transfer at the workplace. The following test procedure is directed toward the recording, on the basis of measurements and observations, of these lighting conditions.
Light security and colour of lighting will also need consideration.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

Level surface.

2.2 Instrumentation

DEVICES FOR MEASUREMENT OF:	PERMISSIBLE ERROR OF MEASUREMENT*
a. Illuminance	5 %
b. Luminance	5 %
c. Distance	2 %
d. Angle	50 mrad

also:
Questionnaires

* The permissible error of measurement for instrumentation is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

AVTP : 09-70
EDITION NO.: FINAL
DATE : SEP. 1991

3. REQUIRED TEST CONDITIONS

3.1 Test Vehicle

a. The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan.

b. Light arrangement according to technical specifications.

3.2 Test Participants

a. Choose test personnel according to the user population or the Military Occupation Speciality requirements.

4. TEST PROCEDURE

4.1 Stationary Tests

a. Data collection must be made with covered optics or at night with hatches closed, if applicable.

b. Tests are to be conducted at minimum and maximum illumination settings.

4.2 Subjective Assessment

a. This assessment is required only under critical illumination or glare conditions that influence the legibility of instruments or produce performance degradation. The functionally correct sitting position is to be adopted at all crew stations.

b. The evaluative rankings should differentiate among at least six levels.

c. The level of confidence should be 95 %, and as further detailed in the parameters for any specific test.

AVTP : 09-70
EDITION NO.: FINAL
DATE : SEP. 1991

5. DATA REQUIRED

a. Intensity of illumination at the display surfaces as well as at the eye height of the required range of the user population.

b. Glare producing light source are to be identified.

c. Measurement angle.

d. Standoff distance.

e. Results of the subjective evaluation.

6. PRESENTATION OF DATA

Present the required data in narrative, tabular, graphical, pictorial or other format as appropriate.

Include:

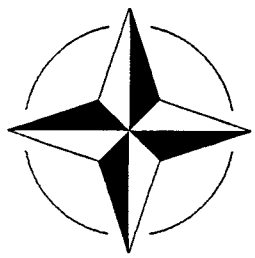
a. Illuminance level for all test conditions.

b. Luminance for all test conditions.

c. Results of the subjective evaluation.

ALLIED
VEHICLE TESTING
PUBLICATION

AVTP : 09-80
EDITION NO.: FINAL
DATE : SEP. 1991



NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : TASK ANALYSIS

REFERENCE : STANAG 4357
STANAG 4358

EQUIVALENT : WEU 4FT6 NO.: TM 09-80

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting tests on sequences of operation of man-machine interface.

AVTP : 09-80
EDITION NO.: FINAL
DATE : SEP. 1991

NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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AVTP : 09-80
EDITION NO.: FINAL
DATE : SEP. 1991

Trial Series: ERGONOMICS

Test Title : TASK ANALYSIS

Paragraph

AVTP : 09-80
EDITION NO.: FINAL
DATE : SEP. 1991

1. SCOPE

The elements of information and sequences of operation required to complete tasks determine decisively the reliability of operation and acceptability of man-machine interface. At the same time, personnel and training requirements are dependant on the crewman's role and the function of the vehicle within the organisational structure it operates in. The following test procedure is directed towards the evaluation of normal and critical driver tasks as determined by measurements and observations. The evaluation of tasks of other crew members is to be carried out according to the same principles.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

As required:
a. Paved test course.
b. Cross-country including sand and mud pits.
c. Water crossing.
d. Obstacles.

2.2 Instrumentation

DEVICES FOR MEASUREMENT OF:	PERMISSIBLE ERROR OF MEASUREMENT*
a. Time	1 %

also:
Film or video equipment, and
questionnaires

* The permissible error of measurement for instrumentation is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

AVTP : 09-80
EDITION NO.: FINAL
DATE : SEP. 1991

3. REQUIRED TEST CONDITIONS

3.1 Test Vehicle

a. The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan.

b. Maintenance and service operations must be performed to ensure that the vehicle is operating within specifications. Give particular attention to controls and instruments.

3.2 Test courses

Conditions representative for standard use of the vehicle.

3.3 Test Participants

a. Choose test participants according to the user population or the Military Occupation Speciality requirements.

b. Anthropometric data for the crew should be related to the required range of the user population as indicated in the test plan.

4. TEST PROCEDURES

a. The functionally correct operating positions are to be adopted at all crew stations.

b. The prescribed representative summer, winter and special clothing is to be used.

4.1 Stationary Tests

Data acquisition must concentrate on the following:

a. Pre and post operation procedures.

b. Vehicle operator maintenance.

c. Entry and exit from each crew station including emergency escape.

d. Rescue of injured.

e. Teamwork and interaction among crewmembers.

f. Deteriorated modes (e.g. missing crew member).

4.2 Mobile Tests

Data Acquisition must concentrate on:

a. Various functions to be fulfilled (e.g. moving with open/closed hatches or NBC-protection).

b. Use of different items of the vehicles equipment (e.g. episcope, sighting equipment).

c. Crew position change.

d. Position change from head out to head in and hatch closed while operating and vice versa.

e. Team interactions.

f. Deteriorated modes (e.g. missing crew member).

4.3 Replication

The investigation of time requirements and action sequences should be carried out with several different test subjects or crews in order to minimise individual differences and provide more reliable data.

4.4 Subjective Evaluation

a. The questions should concentrate on the qualitative assessment of the conduct of work including critical operations and acquiring information which cannot be addressed by direct measurement.

b. The levels of judgement should distinguish among six or more scale values.

c. The level of confidence should be 95 %.

5. DATA REQUIRED

a. Film or video of critical tasks, if required.

b. Time taken to perform tasks.

c. Frequency of tasks.

d. Mental and physical activity levels.

e. Order of operating procedures (flow charts).

f. Details of information logic.

g. Details of tasks requirements carried out differently from training standards.

h. Results of the subjective evaluation.

6. PRESENTATION OF DATA

Present the required data in narrative, tabular, graphical, pictorial or other format as appropriate.

Include:

a. Classification of critical tasks according to the degree of degradation based on measurement and observational evidence.

b. Recommended improvements.

ALLIED
VEHICLE TESTING
PUBLICATION

AVTP : 09-90
EDITION NO.: FINAL
DATE : SEP. 1991

NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : SPEECH INTELLIGIBILITY

REFERENCE : STANAG 4357
STANAG 4358

EQUIVALENT : WEU 4FT6 NO.: TM 09-90

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting tests for speech intelligibility under field conditions.

AVTP : 09-90
EDITION NO.: FINAL
DATE : SEP. 1991

NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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AVTP : 09-90
EDITION NO.: FINAL
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Trial Series: ERGONOMICS

Test Title : SPEECH INTELLIGIBILITY

Paragraph

AVTP : 09-90
EDITION NO.: FINAL
DATE : SEP. 1991

1. SCOPE

Speech intelligibility for the onboard communication systems is a necessary condition for the operation of a man-machine system with multiple crew members. The following test procedures concentrate on the evaluation of speech intelligibility under field conditions as determined from standard speech materials and observation. The investigation of physically derived indices of speech disturbance is not part of this procedure. Such indices can, however, be recorded as a control measure.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

Straight, level paved road course.

2.2 Instrumentation

DEVICES FOR MEASUREMENT OF:	PERMISSIBLE ERROR OF MEASUREMENT*
a. Sound pressure level (measured in dB(A))	1.5 dB
b. Speed	5 %

also:
Speech tests and questionnaires

* The permissible error of measurement for instrumentation is the two-sigma value for a normal distribution; thus, the stated errors should not be exceeded in more than 1 measurement of 20.

AVTP : 09-90
EDITION NO.: FINAL
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3. TEST CONDITIONS

3.1 Test Vehicle

a. The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan.

b. Communication system must be adjusted according to technical specifications for the best possible speech intelligibility. The user must be able to adjust the system to suit himself and the prevailing conditions.

3.2 Test Participants

a. Choose test participants according to the user population or the Military Occupation Specialty requirements.

b. All crew members must have normal hearing measured by audiometric test and be able to speak without strong accent or pronunciation problem.

3.3 Speech Materials

Each country's tests must be quantifiable in such a way that language differences do not affect the results.

4. TEST PROCEDURE

a. Test personnel must be familiar with the test item and test procedures.

b. Each list of numeral, letter or word groups must be used only once during the test.

4.1 Stationary Tests

Perform speech intelligibility tests with all communications systems on, hatches and/or windows closed, and:

a. Engine and auxiliaries off.

b. Engine idling and auxiliaries on.

4.2 Mobile Tests

The road course is to be driven at constant speeds of 30 and 50 km/h, at 2/3 of maximum engine RPM in each gear at maximum safe speed, and at the speed at which maximum resonance occurs.

4.3 Replication

a. Every test subject should take part in all test conditions.

b. A new test phase should be undertaken only when the subjects are free of threshold effects from the preceding trials. Each new test list must be in a different random order to minimise learning effects.

c. The number of trials should be selected to permit a statistical confidence of 95 %, and as further detailed in the parameters for any specific test.

4.4 Subjective Assessment

a. The assessment should concentrate on the qualitative judgement of speech intelligibility.

b. The levels of judgement should distinguish among six or more scale values.

c. The level of confidence should be 95 %.

AVTP : 09-90
EDITION NO.: FINAL
DATE : SEP. 1991

5. DATA REQUIRED

a. Number of correctly understood numeral groups.

b. Number of correctly understood letter groups (e.g. NATO-ALPHABET).

c. Number of correctly understood rhymed words.

d. Identification of the test subjects.

e. Octave band level in dB.

f. Vehicle speed in km/h, gear range, and engine RPM.

g. Results of the subjective assessment.

h. Locations and type of microphones used.

6. PRESENTATION OF DATA

Present the required data in narrative, tabular, graphical, pictorial or other format as appropriate.

Include:

a. Number of correctly understood numbers in %.

b. Number of correctly understood letters in %.

c. Number of correctly understood rhymed words in %.

d. Results of the subjective ratings.

ALLIED
VEHICLE TESTING
PUBLICATION

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NATO INTERNATIONAL STAFF-DEFENCE SUPPORT DIVISION

TRIAL SERIES : ERGONOMICS

TEST TITLE : PSYCHOPHYSICAL STRESS

REFERENCE : STANAG 4357
STANAG 4358

EQUIVALENT : WEU 4FT6 NO.: TM 09-100

FOR COMPLIANCE WITH : -

ABSTRACT : This AVTP describes the procedures for conducting tests on the performance of man-machine-system under operating conditions.

AVTP : 09-100
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NORTH ATLANTIC TREATY ORGANISATION
MILITARY AGENCY FOR STANDARDIZATION (MAS)

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FOR THE MILITARY AGENCY OF STANDARDIZATION

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AVTP : 09-100
EDITION NO.: FINAL
DATE : JAN. 1994

OVERLEAF TO PAGE 3

RESERVATION

United States: Tests requiring human subjects, as part of the materiel acquisition process in the United States military, are not typically performed on a regular basis or reported as technical tests for specific materiel systems. Psychophysical stress parameters are not typically used for criteria in the acquisition of materiel. Human experimentation to develop performance and health hazard data is usually performed as a special study under medical auspices.

AVTP : 09-100
EDITION NO.: FINAL
DATE : SEP. 1991

RECORD OF CHANGES, AMENDMENTS AND RESERVATIONS *)

Identification of Change or Amendment and Reg.No.(if any) and date	Date Entered	NATO Effective Date	By whom entered Signature, Rank, Grade or Rate, Name of Command

*) See Reservations Overleaf

AVTP : 09-100
EDITION NO.: FINAL
DATE : SEP. 1991

Trial Series: ERGONOMICS

Test Title : PSYCHOPHYSICAL STRESS

Paragraph

AVTP : 09-100
EDITION NO.: FINAL
DATE : SEP. 1991

1. SCOPE

The performance and reliability of man-machine system is directly dependent on the psychophysical stress and fatigue under operating conditions. More than that, the ability to cope with psychophysical stress can determine personnel selection and training requirements. The following procedure is directed towards the evaluation of psychophysical stress and fatigue during standardised battlefield days or continuous operation.

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

As required:
a. Roads
b. Cross-country course
c. Gravel course
d. Obstacles

2.2 Instrumentation

Examples:
pertinent indexes with regard
to trial configurations

Psychological variables
a. Reaction
b. Cognitive performance
c. Sensory motor performance
d. Information processing
e. Psychological fitness
f. Other predictors including tests of vision fatigue

Psychosociological demands
a. Confinement
b. Group-related factors
c. Other predictors

Physical variables
a. Heart-beat rate
b. Blood pressure
c. Activities in electroencephalogram (EEG)
d. Muscle activities (EMG)
   i) Handgrip strength
   ii) Upper body strength measurements including Isokinetic (dynamic) strength for shoulder extension / flexion
e. Skin resistance (GSR)
f. Respiratory rate and ventilation including submaximal aerobic capacity and anaerobic capacity
g. Body temperature
h. Physical fitness
i. Other predictors

Questionnaires related to
a. Psychological stress
b. Psychosociological stress
c. Physical stress
d. Sleep amount and quality
e. Workload (Subjective)
f. Percentage efficiency of own performance (self rated)
g. Self reported Activity Log.

3. REQUIRED TEST CONDITIONS

3.1 Test Vehicle

The vehicle must be prepared and equipped to the standard anticipated for operations or as specified by the test plan.

3.2 Test Courses

The test courses should be equivalent to the conditions of a battlefield day or continuous operation.

3.3 Test Participants

a. Choose test participants according to the user population or the Military Occupation Specialty requirements.

b. Anthropometric should be related to the required range of the user population.

c. The prescribed representative summer, winter and special clothing is to be used.

4. TEST PROCEDURES

4.1 Stationary Tests

The portion of the standardised battlefield day or continuously operation should be taken as reference.

4.2 Mobile Tests

As 4.1

4.3 Replication

If possible, the test has to be performed by at least three different crews.

4.4 Objective Assessment

Quantitative measurements as well as subjective evaluation opinion are required

4.5 Subjective Assessment

a. The assessment should concentrate on performance sensitive tests which measure level of stress, strain and fatigue.

b. The level of judgement should distinguish among six or more scale values.

c. The level of confidence should be 95 %.

5. DATA REQUIRED

a. Changes of the stress-predictors as a function of time during selected periods.

b. Effects of single or combined stress on performance.

c. Effects of fatigue on operator performance.

6. PRESENTATION OF DATA

The level of psychophysical stress and the degradation of performance should be determined by means of measurement and observed data.